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VARIATION IN THE SEPIONS OF VICTORIAN CUTTLES (MOLLUSCA : CEPHALOPODA).

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SUMMARY

Data is presented on the variation found in beach stranded cuttle sepions from Victoria, Australia. It is found that the width - length relationship is the most useful enabling the determination for each species of juvenile - adult growth stages, sexual dimorphism and breeding cycles.

INTRODUCTION

Many of the described cuttle species from Australia are based on beach stranded sepions (Iredale 1926, 1954). Species have been separated from each other only on such tenuous grounds as being "wider", "thinner", "longer", "shorter", etc.; these differences being based on few, or even one specimen. Until the ranges of variability of the sepions are known for any species it is fruitless to propose new species on such grounds.

Until a rigorous research and collection programme is undertaken on the distribution and seasonal abundances of the live Sepiidae in Victorian waters we are restricted to observations on beach stranded sepions. From these specimens we must attempt to diagnose species, variation within species, sexual dimorphism within a species, growth rates and breeding cycles.

Detailed descriptions of the variations in length, width, thickness and striate zone length of the Victorian cuttles is presented.

The Victorian fauna of cuttles (Mollusca: Cephalopoda) consists of *Sepia apama* Gray, 1849, *S. braggi* Verco, 1907, *S. hedleyi* Berry, 1918, *S. novaehollandiae* Hoyle, 1909, *S. rex* (Iredale, 1926) (Bell and Plant 1977).

METHODS

The basic premise is that the number of specimens of all ages which are washed onto the beaches is in proportion to those animals living offshore.

The collection of large numbers of beach specimens from Collendina, Ocean Grove, Victoria was made at monthly intervals from July 1976 to July 1977. Two kilometres of beach was thoroughly searched from the seaward edge of the sand dunes to the waters edge (usually low water mark) and all complete and identifiable fragments of sepions were collected.

For all complete specimens the following measurements were made (in mm):

sepion length - greatest length not including the spine if present,
sepion width maximum,
sepion thickness maximum,
striate zone length - measured from the inside of any posterior shelf or outgrowth,
spine length.

From these were calculated the width index - greatest width as a percentage of the sepion length; similarly for a thickness index and a striate zone index.

For the plotted points in each graph a line of best fit was estimated by eye and drawn in.

RESULTS

Sepia apama Gray, 1849

The adult sepion has been adequately described by Adam and Rees (1966) and especially well figured by McCoy (1889). However the juvenile sepion has apparently not been described in detail.

The smallest juvenile sepion found which can be safely identified as *apama* had a length of 5.2 mm. It is roundly triangular in outline, very flat both dorsally and ventrally, with a narrow chitinous margin. There are ten striae visible; the suture lines are ovate at the narrow posterior end but become more quadrate in shape at the anterior. Initially the sepion must be almost circular but quickly changes (in 2-3 chambers) to a more quadrate shape. There is no indication of a spine on the smallest specimen but on a sepion of l = 8.9 mm there is a very small raised boss whilst on sepions of length l = 11 mm and greater there is a small bluntly rounded spine. The spine is present on specimens upto at least l = 240 mm but the posterior end of the sepion is usually abraded in larger specimens. It is apparent that the spine grows with the outer cone as it becomes prolonged.

The thick V - shaped pad at the posterior edge of the hollow on the ventral side in the adults does not begin to appear in juveniles until about l = 75 mm. At this length the inner cone is beginning to thicken and fill the hollow below the inner cone platform. By length l = 90 mm the hollow has been filled and this part of the inner cone is forming thick limbs obscuring the earlier sutures; at this stage the two limbs may be completely fused together posteriorly and smoothly rounded or may be in the form of two slightly separated rounded lobes. There is no apparent change in the outer cone width or length upto l = 90 mm. At greater lengths the outer cone becomes wider and steeper sided with the thickened limbs of the inner cone becoming more pronounced. The outer part of the inner cone begins to cover the outer cone extensions at about l = 110 mm at which length the outer cone is very elongated. This inner cone covering is fused to the outer cone and by length l = 180 mm it covers over half the width of the outer cone at the posterior end but tapers anteriorly. The inner half of this fused inner cone shows a series of sub-parallel growth (?) lines.

(i) Length - width:

The width - length curve shows two relatively straight sections with a 'knee' at a length close to l = 100 mm. For $l < 100$ mm the points lie very close to the line but for $l > 100$ mm the spread of points is larger especially with greater length. Figure 2 shows the width index as a function of length. There is again a notable change in this index with length (i.e. with age) at $l = \pm 100$ mm. For these reasons, together with the growth changes discussed previously, the length of 100 mm has been taken as the dividing length between juvenile and adult sepions. There is no evidence for sexual dimorphism at any stage of growth in these figures. However, when the relative frequency of each width index is found (fig. 3) the histogram is unimodal for $l < 100$ mm but bimodal for $l > 100$ mm. The maximum frequencies are at 47 - 48% for the juveniles and at 34 - 35% and 38 - 39% for the adults. It thus appears that dimorphism only occurs in adult specimens of *apama*. It is not known of course from the sepions which of the maxima corresponds to the male or female animal.

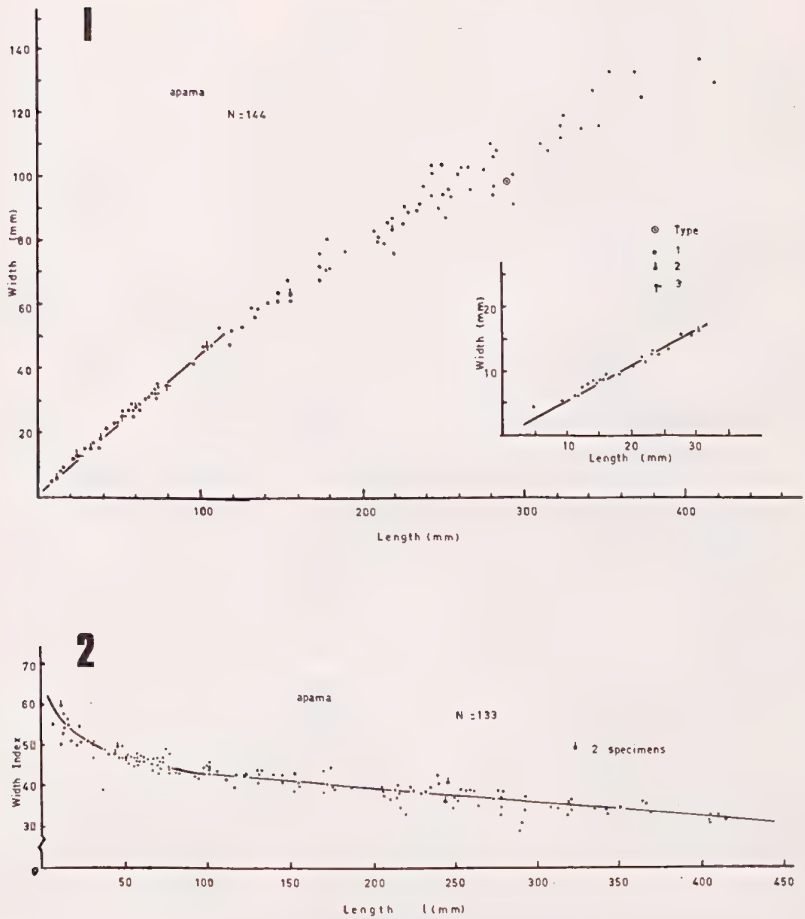
Specimens ranged in length from 6 to 420 mm.

(ii) Length - thickness :

The thickness index frequency curves show no evidence of dimorphism. Two - thirds of all specimens fall within the range 9.5 - 11.5% of the length (fig. 4). Juveniles have a prominent peak at 9.5 - 10% with adults at 11 - 11.5%.

(iii) Length - striate zone :

The striate zone index is quite variable with a range from 48% to 68% for adults with no



FIGURES 1-2.
1. *S. apama* : variation of width of sepion with length. Inset shows the smaller sepions on a larger scale.
2. *S. apama* : variation in width index with sepion length.

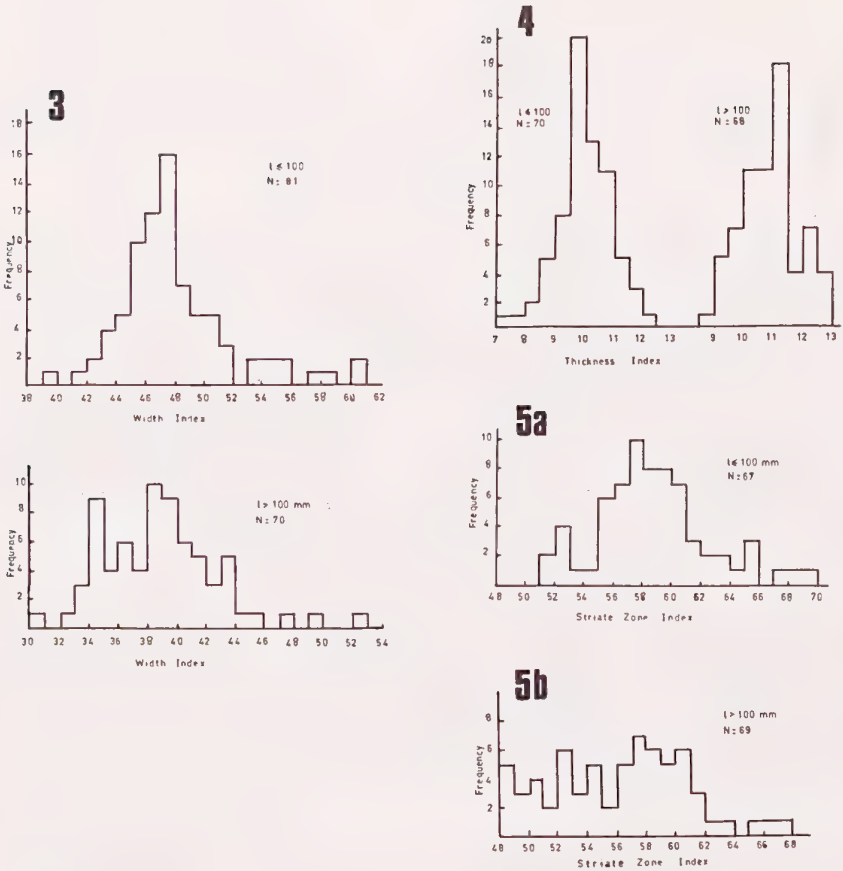
significant peak values. For the juveniles this index shows a wide spread of values with a peak from 56% to 61%. (Fig. 5).

Sepia braggi Verco, 1907

Sepions ranged in size from 6.5 mm to 66 mm. Small specimens were uncommon; the majority having lengths between 40 mm and 60 mm. This may be partly due to the fragile form of the juveniles and possibly to a different living habitat.

(i) Length - width :

The length - width curve (fig. 6) shows all specimens to lie, apart from the smallest, along a single growth line. The variation in width for a given length increases with greater length but



FIGURES 3-5.
3. *S. apama* : histograms of frequency of width index values.
4. *S. apama* : histogram of frequency of thickness index values.
5. *S. apama* : histogram of frequency of striate zone index values.

is not greater than 10%. The width index curve (fig 7) shows the characteristic shape of a rapidly falling curve initially and then a much slower growth change. The change in growth rate occurs at length $l = \pm 40$ mm. Indeed, for $l > 50$ mm the curve is almost horizontal. The sepions only show variations of width index for $l > 40$ mm, so this length is taken as the juvenile - adult change length.

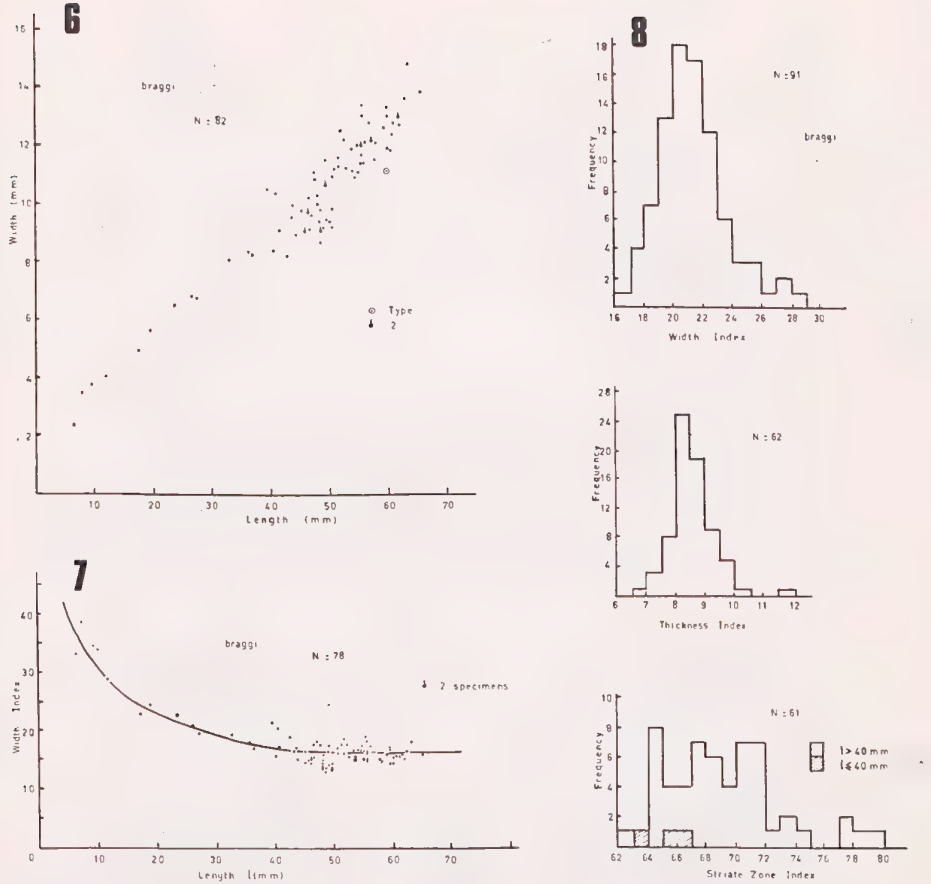
The histogram for width index (fig. 8) is unimodal with a maximum at 20 - 22%. There is no evidence for sexual dimorphism.

(ii) Length - thickness :

The thickness index (fig. 8) is strongly unimodal with the peak at 8 - 9%.

(iii) Length - striate zone :

Wide variation occurs in the length of the striate zone on the sepions studied. The striate zone index (fig. 8) ranges from 50.8% to 79%. The four smallest sepions, lengths 11.8, 23.8, 26.4 and 27.4 mm, had indices of 50.8, 53.4, 56.4 and 52.6% respectively. (These values are not shown on figure 8).

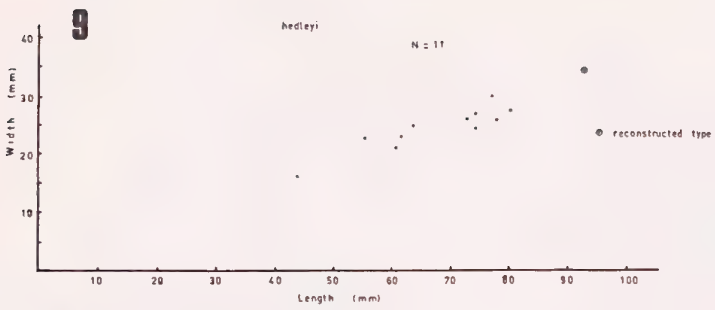


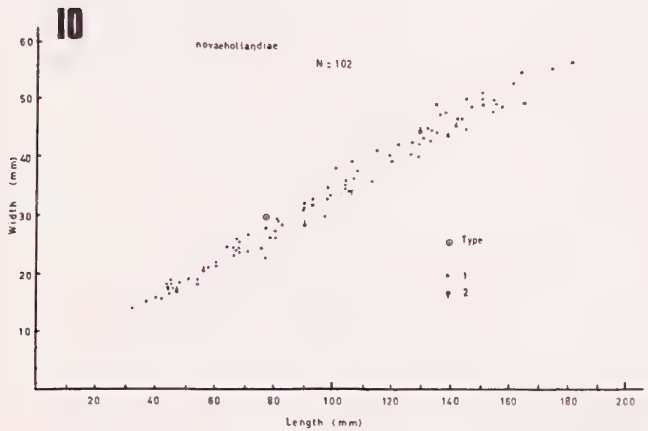
FIGURES 6-8.
6. *S. braggi* : variation in width of sepion with length.
7. *S. braggi* : variation of width index with sepion length.
8. *S. braggi* : histograms of frequency of width index, thickness index and striate zone index values.

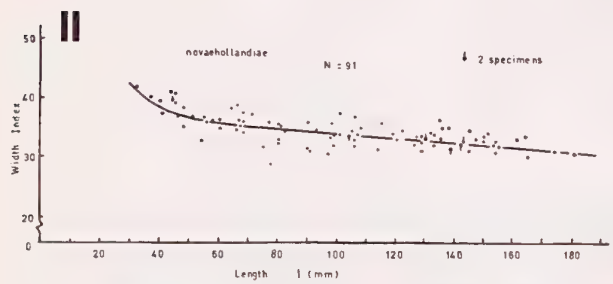
Sepia hedleyi Berry, 1918

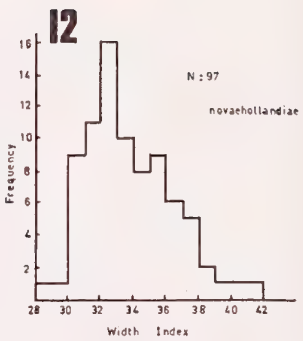
Sepions of *hedleyi* are sparse on the Victorian coast. This is most likely due to their living habitat of deep waters upto at least 500 metre.

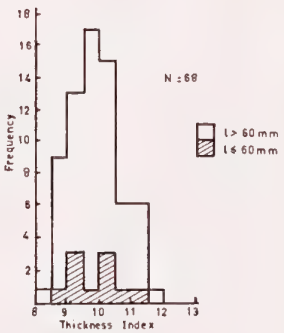
The sepion of *hedleyi* has not been adequately figured. The original figured by Berry (1918) was a reconstruction of a badly broken and dissolved sepion. Cotton and Godfrey (1940) gave a figure of a sepion they called *hedleyi* but Adam and Rees (1966) doubted that it was actually of *hedleyi.* In the N.M.V. collections there are live taken animals from Portland, Victoria, which agree with Berry's description of *hedleyi;* the sepions of these specimens are closely similar to Berry's reconstructed sepion and are the same as that figured by Cotton and Godfrey. The figure of *hedleyi* given by Cotton (1929) is more acuminate anteriorly than any from the live animals but some of the beach stranded specimens are similarly shaped. From the sepions of *hedleyi* seen (this collection, live taken animals and an extensive range from Merimbula, N.S.W.) the acuteness or otherwise of the anterior end is a quite variable character. Sepions ranged in length from 44 to 81 mm. Little can be deduced from such a small number of specimens but the width - length plot (fig. 9) shows that all points, including that of the reconstructed type, fall on a single straight line.

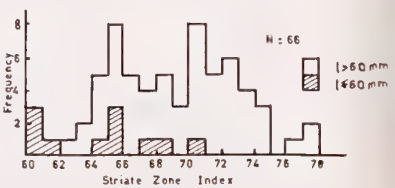












FIGURES 9-12.

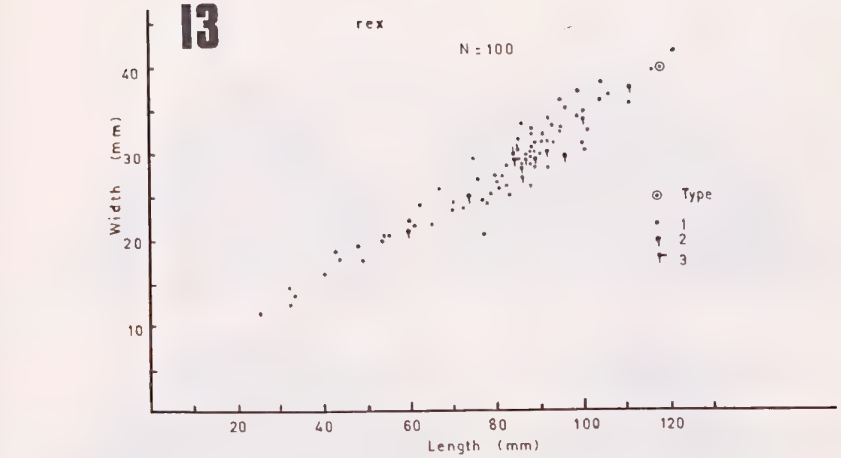
9. *S. hedleyi* : **variation of width of sepion with length.**
10. *S. novaehollandiae* : **variation of width of sepion with length.**
11. *S. novaehollandiae* : **variation of width index with length.**
12. *S. novaehollandiae* : **histograms of frequency of width index, thickness index and striate zone index values.**

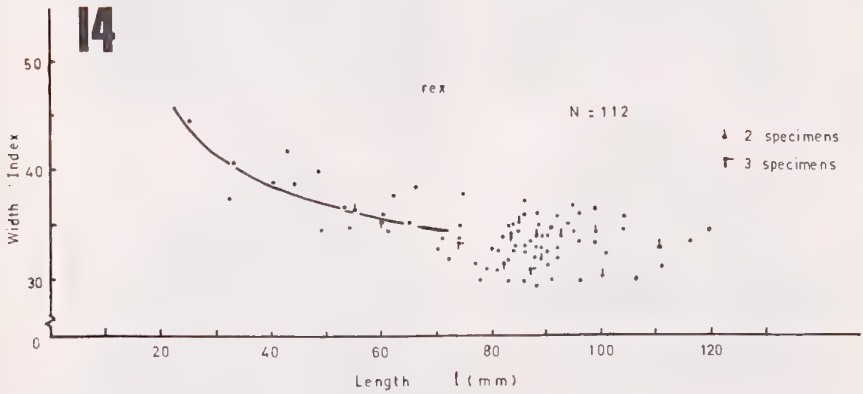
Sepia novaehollandiae Hoyle, 1909

(i) Length - width :

Sepions ranged in size from 40 to 180 mm. The length - width relationship remains constant over this range (fig. 10) with specimens only showing width variations for a given length for $l > 60$ mm. This length has been taken as representing the juvenile - adult length. As with other species the variations are greatest with increasing lengths.

The width index curve (fig. 11) shows the characteristic rapid decrease for juveniles ($l < 60$ mm) and then a slower more gradual decrease.





FIGURES 13-14.
13. *S. rex* : variation of width of sepion with length.
14. *S. rex* : variation of width index with sepion length.

There is no evidence for dimorphism in the sepions as the width index histogram (fig. 12) shows a unimodal curve with maximum frequency at 32 - 33%.

(ii) Length - thickness :

There is little variation in the relative thickness of the sepions. The range is from 8.5 - 11.6% with a maximum number of specimens between 9.5 - 10% (fig. 12).

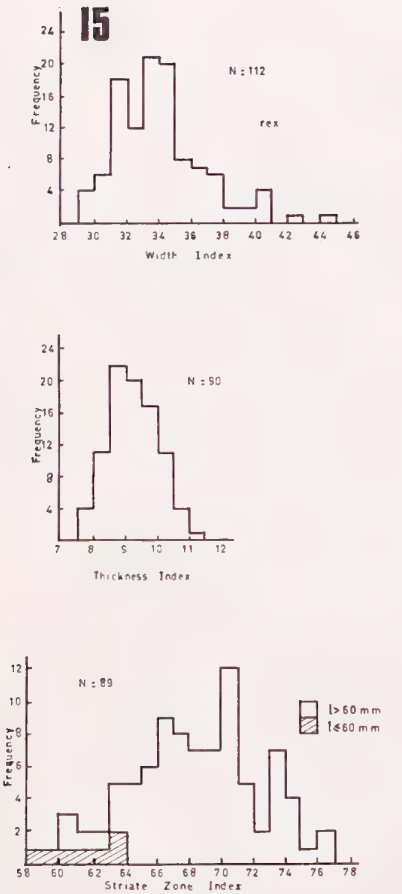
(iii) Length - striate zone :

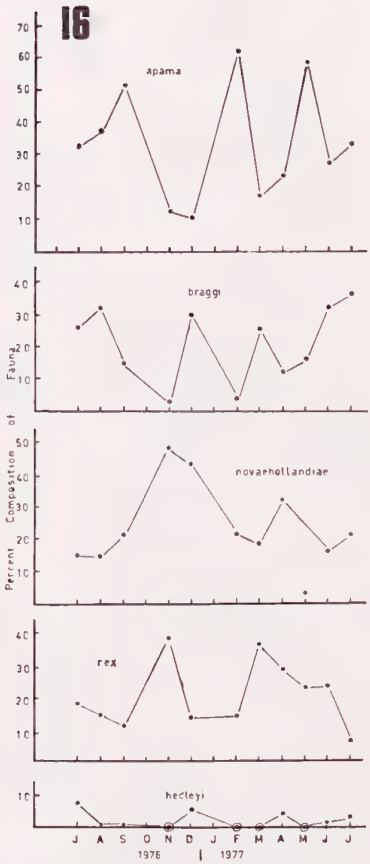
The juveniles show a striate zone index peak of 64 - 65% while the adults show a bimodal pattern (fig. 12).

Sepia rex (Iredale, 1926)

(i) Length - width :

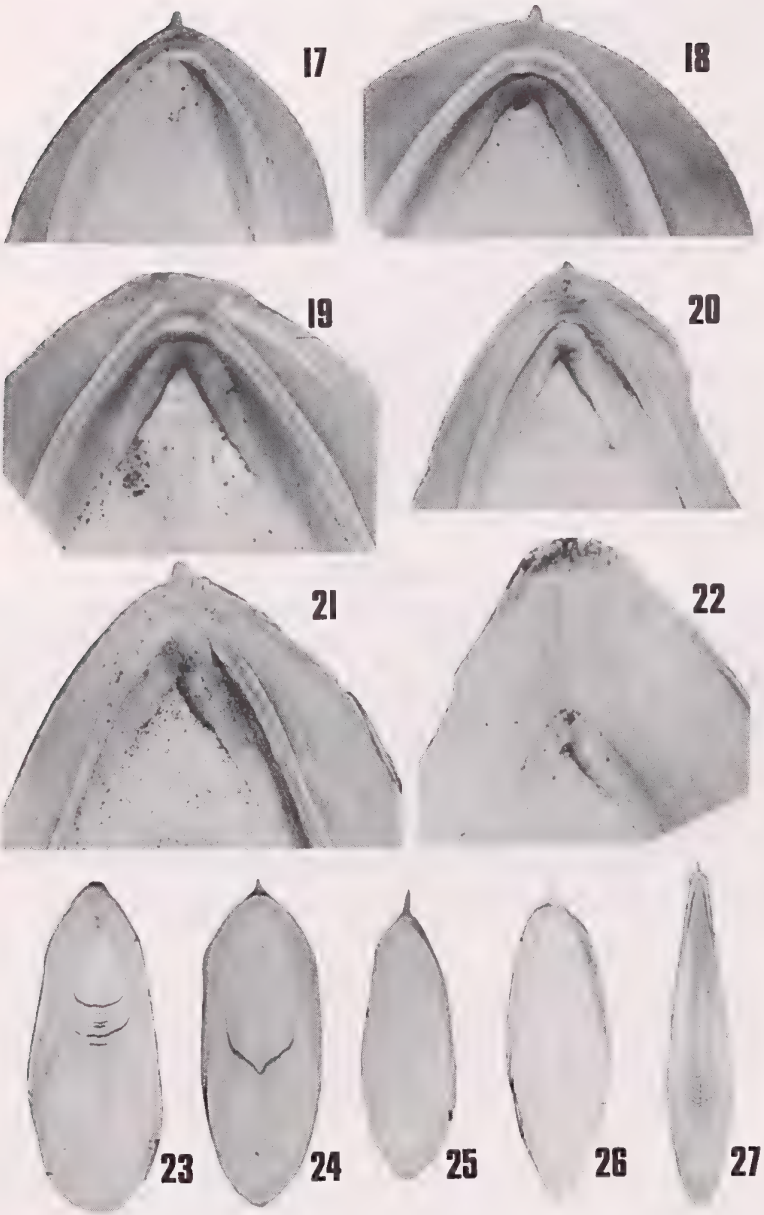
Sepions ranged in length from 26 mm to 121 mm. This species shows the greatest spread in length - width relationship of all the species considered. (fig. 13, 14). Small specimens were uncommon but there is evidence that at length l = 60 mm the spread in width values for a given length becomes much greater. This length is thus taken as the length of juvenile to adult change. The width index histogram (fig. 15) is bimodal with maxima at 31 - 32% and 33 - 35%. *Sepia rex* therefore shows more pronounced dimorphism than any of the other species.





FIGURES 15-16.
15. *S. rex* : histograms of frequency of width index, thickness index,and striate zone index values.
16. Variation in the faunal composition with date of collection.

FIGURES 17-27.
17-22. *Sepia apama*, showing the development of the posterior ventral thickening with increasing length. 17, l = 56 mm; 18, l = 75 mm; 19, l = 96 mm; 20, l = 110 mm; 21, l = 156 mm; 22, l = 180 mm.
23. *Sepia apama.*
24. *Sepia novaehollandiae.*
25. *Sepia hedleyi.*
26. *Sepia rex.*
27. *Sepia braggi.*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(ii) Length-thickness :

The thickness index (fig. 15) is strongly unimodal with maximum at 8.5 - 9.5% with a range of 7.5 - 11.2%.

(iii) Length-striate zone :

This index shows a very wide range in adult specimens - from 60 to 77%. The juveniles have a much restricted range of 58 - 64% (fig. 15).

Faunal Variation with Time

The overall variation in the faunal composition of the collected specimens is shown in fig. 16. Several points are of interest. Neglecting the variation in *hedleyi* as it is due to such few specimens taken, the other four species show pronounced variations over the 12 month period. Also, there is a clear inverse relationship between the presence of *apama* and *novaehollandiae*. It was at first thought that these faunal variations were due to the input of juveniles due to various cyclic breeding times. However, an analysis of the number of juveniles of *apama* present each month (the only species to have sufficient juveniles for analysis) shows this not to be the case as hatching of young occurred only once per year (Bell, 1979).

Discussion

This short study has shown that the sepion variation within a species of cuttle is a function of the sepion length i.e. a function of the age of the animal. The variation for a given age is rather restricted and where large e.g. *rex*, is most likely due to sexual dimorphism in the adult. In all species the juvenile animals give no indication of dimorphism. It is only after a certain length, taken here to represent the change from juvenile to adult, that any dimorphism or variability in the parameters measured becomes evident. Bearing this in mind it is thus possible to use the cuttle sepions to characterize species.

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